Relationship Between Body Length and Number of Nipples in Swine

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Story in Brief

The objective of this study was to estimate the relationship between number of nipples (NT) counted at 100 days of age and body length at the end of performance test in Yorkshire swine. Data consisted of performance test records collected in a commercial swine operation from 1992 to 1995. At 100 days of age pigs were weighed (WT100) and selected for performance testing based on a combination of maternal and performance indexes which differed by breed. Body length (LEN) was measured at the end of the 77-day performance test. Genetic parameters were estimated using an animal model with litter effects and multiple-trait DFREML procedures. The model included WT100, LEN, and NT. Contemporary group was included as a fixed effect. Age at 100 days was included as a covariate for WT100, and age at 177 days was included as a covariate for LEN. Heritability estimates were 0.25 for WT100, 0.26 for LEN, and 0.29 for NT. Genetic correlations were 0.72 between WT100 and LEN, 0.21 between WT100 and NT, and 0.04 between LEN and NT. Correlations indicated very little or no relationship between LEN and NT for this population of Yorkshire swine.

Introduction

Much effort has been devoted to the improvement of litter size in swine due to its impact on productive and economic efficiency. Mesa et al. (2003) reported that 14 generations of selection had resulted in a difference between lines of three fully formed piglets at birth. As litter size increases, having an adequate number of nipples to accommodate all pigs in the litter if the sow is to rear them herself may become a limiting factor. It seems logical that a sow that has a longer body would have room for more nipples than a sow with a shorter body, and that there might be a relationship between these two traits. The objective of this study was to estimate heritability of number of nipples and to examine the relationship between this trait and body length measured at the end of postweaning performance tests for a population of Yorkshire swine.

Experimental Procedures

Data for this study consisted of performance test records of Yorkshire pigs collected in a commercial swine operation (The Pork Group, A Division of Tyson Foods, Inc., Rogers, AR) from 1992 to 1995. Two indexes (breeding values) for each animal were calculated at birth. One was a maternal index based on number born alive, farrowing interval, and litter weaning weight. The other was based on growth rate, leanness, and feed efficiency (Grow-Fin). The maternal index was computed using a three-trait model that included terms for the additive genetic effect, litter effects, and maternal genetic effects along with appropriate fixed effects. The Grow-Fin index was computed using a model that included only additive genetic effects and appropriate fixed effects. These two indexes were combined into an overall ranking with more emphasis given to the maternal index in Yorkshire. Boars from approximately 60% of the litters were culled at weaning based on the breed specific index. Culled boars (barrows) were grown out and slaughtered. For economic reasons, these animals were not performance tested. Remaining boars and all females were grown to 100 days of age. At this time number of nipples were counted (NT) and all pigs were weighed (WT100). A second culling event occurred with recalculated indexes using any new information collected on animals in the breed. Fifty to sixty percent of the females and 20 to 25% of the remaining boars were performance tested for approximately 77 days.

Boars were individually penned in 2.79 m^2 pens with slotted gating on slatted concrete floors. Barns were curtain-sided buildings that were tunnel ventilated in the winter. Boars were fed for ad libitum consumption a pelleted corn-soybean meal diet that was 1.14% lysine, 19% protein, and 3,344 mcal/kg ME. Exact composition of the diet varied due to ingredient cost. Gilts were fed this same diet in groups of 8 to 10 pigs in a pen with each pig having an area of 1.2 m^2. Different size pens were available in different facilities, so pens in some barns held eight pigs and in other barns 10 pigs. All pigs had ad libitum access to water. All pigs were weighed at the end of the 77 day performance test, and body length (LEN) was measured from the top of the tail to the point of the shoulder when the head is down.

Contemporary group was defined as all pigs of the same sex reared in the same house and started on test within a 3-mo period (quarter of a year). Data sets were edited to remove records of animals with missing sire or dam. Some description of the data sets is given in Table 1. There were 58 contemporary groups with 191 sires, 1,417 dams and 3,475 litters.

For each breed, genetic parameters were estimated using an animal model with litter effects and multiple-trait DFREML procedures (MTDFREML; Boldman et al., 1993; Boldman and Van Vleck, 1991). A three-trait model including WT100, LEN, and NT was used. Contemporary group was a fixed effect. Initial test age (AGE100) was a covariate for WT100, and final test age (AGE177) was a covariate for LEN. The WT100 was included in each analysis in an attempt to remove bias due to selection at 100 days of age; not all pigs weighed at 100 days of age were performance tested.

Results and Discussion

Means and standard deviations are given in Table 2. Mean weight was 101.80 lb at the beginning of the performance test and

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256.96 lb at the end of the performance test. Mean LEN was 37.49 in, and average NT was 14.08.

Estimates of heritability were 0.25 for WT100, 0.29 for NT, and 0.26 for LEN (Table 3). These estimates are in the low to moderate range indicating that additive genetic variance does exist for these traits and progress in changing them could be made through selection. No literature estimates of heritability of body length were found. Cassady et al. (2002) reported estimates of heritability of number of nipples of 0.37 ± 0.03 in one experiment using Landrace, Yorkshire, Large White and Chester White pigs and 0.43 ± 0.03 in a second experiment using Duroc, Hampshire, Pietran, and Spot pigs. Pumfrey et al. (1980) reported a paternal half-sib estimate of heritability for number of teats of 0.32 using the University of Nebraska Gene Pool population. The genetic correlation between WT100 and body length was high (0.72). Estimates of genetic correlation for WT100 with NT and for LEN with NT were 0.21 and 0.04, respectively, indicating that neither of these traits would be good candidates for selection to increase NT in swine.

Common environmental litter effects explained 19% of the phenotypic variance for WT100, 16% of the phenotypic variance for LEN, but only 5% of the phenotypic variance for NT, indicating that this trait is not influenced by common litter effects.

Table 1. Some description of the data.

Item	Number
Contemporary groups	58
Sires	191
Dams	1,417
Litters	3,475
Individuals in pedigree matrix (A^{-1})	20,634

Table 2. Means and standard deviations for traits in analysis.

Trait[a]	N	Mean	SD
Age100, d	19,442	99.94	3.30
WT100, lb	19,442	101.80	16.32
Age177, d	9,299	176.64	3.92
WT177, lb	9,299	256.96	29.03
Body length, in	9,292	37.49	2.18
Number of nipples	18,986	14.08	0.58

[a] WT100 is weight at 100 days of age; WT177 is weight at 177 days of age and body length is measured at the end of performance test.

Implications

Heritability estimates are high enough to indicate that additive genetic variance does exist for weight at 100 days of age, number of nipples, and body length at the end of performance test. Each of these traits could be improved by selection; however low genetic correlations with number of nipples implies that selection for weight at 100 days of age or body length at the end of performance test will have little effect on number of nipples.

Literature Cited

Boldman, K., et al. 1993. A manual for use of MTDFREML - A set of programs to obtain estimates of variances and covariances. ARS, USDA, Washington, DC.

Boldman, K. G., and L. D. Van Vleck. 1991. J. Dairy Sci. 74:4337-4343.

Cassady, J. P., et al., 2002. J. Anim. Sci. 80:2303-2315.

Mesa, H., et al. 2003. J. Anim. Sci. 81:74-79.

Pumfrey, R. A., et al. 1980. J. Anim. Sci. 50:1057-1060.

Table 3.Genetic parameters for weight and number of nipples at 100 days of age, and body length at the end of performance test.

Item[a]	Parameter estimate
h^2 WT100	0.25
h^2 Number of nipples	0.29
h^2 Body length	0.26
rg WT100 with LEN	0.72
rg WT100 with number of nipples	0.21
rg LEN with number of nipples	0.04
c^2 WT100	0.19
c^2 Number of nipples	0.05
c^2 Body length	0.16

[a] WT100 is weight at 100 days of age; and body length (LEN) is body length measured at the end of performance test. h^2 is estimate of heritability; rg is estimate of genetic correlation; and c^2 is estimate of common environmental litter effect.